

Ponderosa Pine Tree Selection by Roosting Merriam's Turkeys in North-Central Arizona

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Abstract: We compared ponderosa pine (*Pinus ponderosa*) trees used for roosting by Merriam's turkeys (*Meleagris gallopavo merriami*) in north-central Arizona with randomly selected ponderosa pine trees ≥ 40 cm diameter breast height (dbh) to determine which factors best identified trees that Merriam's turkey select for roosting. Roost trees were older ($P = 0.007$), greater in diameter ($P < 0.001$), taller ($P < 0.001$), had greater surrounding basal area (BA; $P = 0.086$), and had a greater height to first limb ($P = 0.063$) than did randomly-located, ≥ 40 cm diameter trees. A logistic regression model, developed using a forward-stepwise approach, correctly classified 92.3% of all trees. Our model can be used to identify potential turkey roost trees by using only tree dbh and immediately surrounding BA. Used in conjunction with existing models, this model now allows managers to more accurately rank and prioritize potential roosting habitat for land management planning.

Key words: *Meleagris gallopavo merriami*, Merriam's turkey, ponderosa pine, roost.

INTRODUCTION

Merriam's turkeys consistently select clumps of the largest ponderosa pine trees for roosting (Hoffman 1968, Scott and Boeker 1977, Rumble 1992, Mollohan et al. 1995, Wakeling and Rogers 1996, 1998); therefore, habitat selected for roosting may be more characteristic and easily identified than other habitats that turkeys occupy. Most trees used for roosting exceed 40 cm diameter breast height (dbh) (Boeker and Scott 1969, Mackey 1984, Mollohan et al. 1995). In addition to large trees, high basal area (BA) ($>20 \text{ m}^2/\text{ha}$), dense overstory canopy ($>50\%$ closure), and steep slopes ($>30\%$) are other characteristics common to roosting habitat (Boeker and Scott 1969, Mackey 1984, Rumble 1992). Conversely, aspect and landform were selected less consistently by roosting turkeys, depending on season and area (Schemnitz et al. 1985, Rumble 1992, Mollohan et al. 1995, Wakeling and Rogers 1996, 1998). Mollohan et al. (1995) found that trees with characteristics selected by roosting turkeys were extremely rare when compared with availability of those characteristics throughout the forests of north-central Arizona.

Merriam's turkeys predominately limit diurnal activities to within 1.6 km of roosting sites (Wakeling 1997), and inadvertent removal or isolation of a roosting site, through management activities such as timber harvest, can be detrimental to Merriam's turkey populations (Scott and Boeker 1977). In recognition of this fact, protection of known roosting sites has been a practice of most land management agencies since the mid-1980s. But in many instances, documentation of roosting sites can be difficult and has not occurred. Numerous descriptions of roosting habitats have been developed (Boeker and Scott 1969, Phillips 1980, Rumble 1992), including qualitative (Mollohan et al. 1995) and mathematical models (Wakeling and Rogers 1996, 1998) that may be used to identify suitable roosting areas. Turkeys seem to select roosting sites in part by individual tree characteristics, yet no mathematical model is available to assist in the identification of suitable roost trees.

We studied the differences between known roost trees at Merriam's turkey roosting sites in northern Arizona and paired, randomly located ponderosa pine trees $\geq 40\text{cm}$ dbh. Our objective was to infer from this comparison if Merriam's turkeys differentiated among large trees when selecting roosts. A second objective was to develop a mathematical model that would assist resource managers to more easily identify suitable roosting trees in north-central Arizona.

STUDY AREA

We studied roost trees in ponderosa pine forests south of Flagstaff, Arizona, on the Coconino National Forest and south of Winslow, Arizona, on the Apache-Sitgreaves National Forests. All roosting sites occurred within mixed conifer or ponderosa pine habitat associations, at elevations of 1,850 to 2,450 m, within areas that had been previously studied by Mollohan et al. (1995) and Wakeling and Rogers (1998). Greater detail of habitat descriptions may be found in Wakeling and Rogers (1998).

METHODS

We measured characteristics associated with 13 ponderosa pine trees that had been used by roosting Merriam's turkeys and on 13 paired, randomly located ≥ 40 cm dbh ponderosa pine trees. We randomly selected 1-2 roost trees from eight roosting sites that had been located during previous Merriam's turkey research studies (Mollohan et al. 1995, Wakeling and Rogers 1996, 1998). The random roost trees were selected by identifying the closest known roost tree on a computer-generated random bearing from the geographic center of a roosting site. The eight roosting sites represented three winter roosts, three summer roosts, and two roosts from yearlong range. We sampled two trees from each winter and yearlong roosting site and one tree from each summer roosting site because winter and yearlong roosting sites contained 2-3 times as many trees as summer roosting sites.

We measured the following variables specific to each roost tree: dbh with a diameter tape; tree height and height to first limb by measuring a known distance perpendicular to the tree with a tape and using a clinometer to measure angles to the apex, first limb, and base of the tree; age of tree, by extracting a core sample from the tree with an increment bore (the sample was marked and tree rings enumerated later using a 10X magnification microscope in the laboratory); and presence or absence of horizontal branches >3 cm diameter within the upper third of the tree crown that approximated a level perching surface (i.e., $< 10\%$ slope).

In addition, we collected information pertaining to the site surrounding the roost tree. We measured slope (%) from 15 m above to 15 m below the roost tree using a clinometer. Stem density of trees >2.5 cm dbh was enumerated on a 0.05-ha circular plot (12.6-m radius). We calculated percent canopy closure according to Strickler (1959) by taking readings with a spherical densiometer at site center and at 12.6 m from site center on four bearings, each 90 degrees from the previous, with the first bearing randomly oriented. We used a 10-factor prism to estimate basal area (BA) surrounding the roost tree.

Immediately upon completing measurements on the roost tree, we randomly located a ponderosa pine tree >40 cm dbh for comparison. These random trees included trees within and outside the roosting site because we were unable to determine conclusively if all trees within a site had been used for roosting. To locate random trees, we walked a computer-generated random bearing for a distance of 40-500m. When we reached the random distance, we continued along the bearing until encountering the first ponderosa pine tree >40 cm dbh. We then recorded the same measurements taken at the roost tree.

We analyzed data using paired *t*-tests for continuous data (i.e., age, diameter, height, stem density, BA, slope, height to first limb, and canopy closure) and contingency tables for categorical data (i.e., horizontal branch presence). We then included all variables in a forward-stepwise logistic regression equation (Hosmer and Lemeshow 1989) to determine what variables best predicted roost tree identification.

RESULTS

We found that many characteristics differed between roost and random trees: roost trees averaged greater age ($P=0.007$), dbh ($P<0.001$), height ($P<0.001$), height to first limb ($P=0.063$), and basal area (BA) ($P=0.086$) surrounding the tree (Table 1). Roost and random trees had the same number of horizontal branches (12 of 13)

Table 1. Mean (SD) and paired t -test probabilities (P) for characteristics of random ponderosa pine trees and those selected for roosting by Merriam's turkeys, in north-central Arizona.

Characteristic	Roost tree ($n = 13$)	Random tree ($n = 13$)	P
Age of tree (years)	161.5 (48.8)	104.6 (49.5)	0.007
Diameter at breast height (cm)	71.4 (12.0)	48.1 (7.6)	<0.001
Height of tree (m)	27.1 (4.0)	19.1 (5.1)	<0.001
Stem density on 0.5-ha circular plot	21.0 (9.8)	19.9 (12.2)	0.792
Basal area surrounding roost tree (m ² /ha)	21.5 (8.3)	16.2 (6.7)	0.086
Slope at roost tree (%)	15.8 (11.2)	16.2 (15.4)	0.931
Height to first limb (m)	5.9 (2.5)	3.9 (2.7)	0.063
Canopy closure (%)	49.3 (15.9)	44.2 (21.8)	0.503

while slope and percent canopy closure did not differ between sites. The logistic regression model correctly classified 92.3% of roost vs. non-roost trees at all locations (Table 2). In this model, roost trees were associated with greater tree dbh and surrounding BA than were randomly located trees >40 cm dbh.

Table 2. Logistic regression model (logit scale) explaining ponderosa pine roost tree selection by Merriam's turkey in north-central Arizona.

n	χ^2	P	Model ^a	Percent correct		
				Used	Random	Overall
13	13	26.5	<0.001	Y=-20.266+0.055BA+0.274DBH	92.3	92.3

^a BA is the basal area (m²/ha) surrounding the roost tree, and DBH is the diameter at breast height (cm) of the roost tree.

DISCUSSION

Although many studies have found that 40 cm dbh was the minimum size roost tree used by Merriam's turkeys, and large, overmature ponderosa pine trees are most suitable for roosting, we speculate that 40 cm dbh is not a functional minimal threshold for roost tree diameter. Rumble (1992) found Merriam's turkeys using ponderosa pine trees < 40 cm dbh in the Black Hills, South Dakota, but these were the largest trees available on his study site. Because turkeys strongly favored trees that were older, taller, and larger diameter than the average ≥ 40 cm dbh tree in our study, we suggest that there may not be a critical minimum above which tree diameter becomes irrelevant. Although Merriam's turkeys inhabit areas that lack larger trees, they seem to consistently prefer the largest available trees.

Basal area (BA) is apparently also influential in the selection of roost trees. Greater BA seems favorable to roosting site selection regardless of maximum available BA. Even in South Dakota second growth ponderosa pine, Rumble (1992) found Merriam's turkeys roosting in sites with >20 m²/ha BA. Thus, selection of roosting sites by Merriam's turkeys consistently favors older, mature trees with high surrounding BA.

Our logistic regression model can be used to assist in prioritizing potential roosting sites and roost trees when planning land management activities such as timber harvest or other impact developments. This roost tree model can be used in conjunction with broader scale models provided for roosting site selection during winter (Wakeling and Rogers 1996) or summer (Wakeling and Rogers 1998; Table 3). Roosting site models could be used to identify potential roosting habitat, whereas the roost tree model could be used to assist with ranking priorities on trees within those potential sites. Sites with similar scores from roosting habitat models could be protected and managed for roosting habitat regardless of the score, if Merriam's turkeys are a featured management species. In accordance with Wakeling (1997), roosting sites should be managed at tree densities of ≥ 1.25 /km².

Table 3. Logistic regression models (logit scale) describing Merriam's turkey roosting site selection during winter and summer in north-central Arizona.

Season	Model ^a	Citation
Winter	$Y = -21.290 + 9.803\text{CPY} + 0.742\text{PD} + 0.386\text{SLOPE}$	Wakeling and Rogers (1996)
Summer	$Y = -6.614 + 1.435\text{CG} + 0.160\text{PBA} + 0.101\text{SLOPE}$	Wakeling and Rogers (1998)

^a CPY is closed overhead canopy presence (absent = 0, present = 1), PD is the mean ponderosa pine diameter at breast height (cm), SLOPE is slope at site (%), CG is conifer ground cover <46 cm in height (%), and PBA is the basal area provided by ponderosa pine at the site (m²/ha).

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